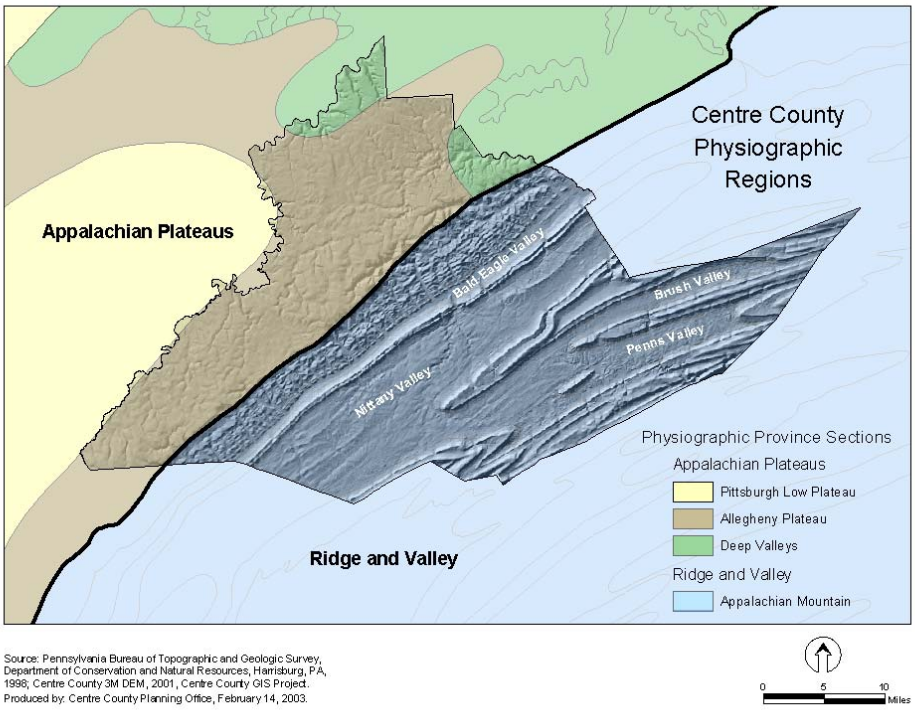
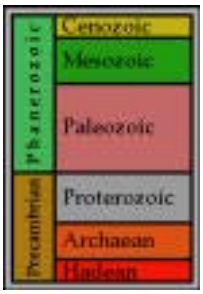


NATURAL RESOURCES

GEOLOGY AND MINERAL RESOURCES

GEOLOGY



Centre County is located within two major physiographic provinces: the Appalachian Plateaus Province and the Ridge and Valley Province. The Appalachian Plateaus Province is found in the west and northwest portions of the County and is characterized by nearly horizontal rock strata which have not been deformed to any great extent by major earth disturbances (tectonic forces)[1]. The Ridge and Valley Province is found in the south and southeast sections of the County. The angle of bedrock bedding, or dip, varies widely through this area as result of folding. The fracturing of the rocks at the uppermost parts of the folds has accelerated the erosion of limestone strata. The less easily eroded sandstone strata form the ridges which currently exist in the area.

Limestones and dolomites of the Cambrian and Ordovician Systems are the most productive water-bearers in the County and supply several large springs. The largest of these springs is located at Bellefonte, the Big Spring. In areas of the County where shale occurs, wells and springs do not yield as much water as might be expected in limestone areas. The shale is, for the most part, highly fractured and does not confine water. Consequently, such areas are of little value as sources of underground water. Formations of the Mississippian and Pennsylvanian Systems yield more water than those which are comprised entirely of shale, although they are not usually as productive as the limestone valleys. Soils formed from shale typically are not the best for agricultural uses. These soils usually are not drained, which poses challenges for development. Large scale development on shale may face constraints from the tendency of this formation to slip when saturated.

Following is a map entitled Geologic Units (Figure 1) showing the major bedrock units of the County in chronological order beginning with the youngest unit:

Allegheny Group

The Allegheny Group of the Pennsylvanian System crops out in small areas in the northern portion of the County and ranges in thickness from 220 to 350 feet. The Group consists of variable layers of sandstone, shale, limestone, clay and coal. (Bituminous coal has been extensively mined from this Group. Flint clay has also been extracted from an area north of Snow Shoe). Water is usually available in small quantities.

Pottsville

The Pottsville Group of the Pennsylvanian System is comprised primarily of hard sandstone and forms extensive flat summits in the northwestern portion of the County. The Group includes three subdivisions, namely, Homewood sandstone, Mercer shale and Connoquenessing sandstone. The Homewood sandstone generally consists of large white or light gray coarse-grained sandstone. Mercer shale underlies the Homewood sandstone and consists of shale and clay. The Connoquenessing Sandstone is the lowest Member of the Formation and is generally gray, hard, coarse, thick-bedded sandstone although in some areas it is white and fine-grained. Large quantities of water are likely to be found, however, usually of poor quality with high mineral content.

Mauch Chunk Formation

The Mauch Chunk Formation of the Mississippian System is comprised of red shale with brown to greenish-gray sandstone. It is characteristic of this Formation that water is available in depths up to 100 feet. The water generally is of poor quality with a high iron content.

Pocono Group

The Pocono Group of the Mississippian System consists primarily of hard, resistant sandstone and includes two subdivisions: (1) Burgoon sandstone comprises the upper portion of the Group and consists of thick-bedded, coarse,

[1] A good place to observe this is the Route 322 cut between Port Matilda and Philipsburg. As you drive north towards Philipsburg the angle of the rock gets closer to horizontal.

Geologic Map of Centre County

yellowish-green to bluish-gray sandstone which is locally conglomeratic. It ranges in thickness from 300 to 525 feet. (2) The lower subdivision is unnamed and consists of gray, sandy shale, gray and red sandstone, red shale and locally, beds of clay and conglomerate. Thin beds of coal may also be encountered locally. Water is often present, particularly when the Group is covered by the Mauch Chunk Formation. Water quality is usually good and soft.

Susquehanna Group

The Susquehanna Group of the Upper Devonian Series consists of three subdivisions: (1) Oswayo Formation, primarily brownish and greenish, fine and medium grained sandstone with some shales in the upper portion of the Group; (2) Catskill Formation, chiefly red to brownish shales and sandstone in the middle portion; and (3) Marine beds of gray to olive brown shales, graywackes and sandstones in the bottom portion of the Group.

Hamilton Group

The Hamilton Group of the Middle Devonian Series generally consists of brown, yellow, olive-green and black shales with some interbedded sandstones. These sandstones are thick and predominate in some areas. Water in moderate quantity is found and often iron and hydrogen sulphide are encountered.

Oriskany and Helderberg Formations

These two Formations are of the Lower Devonian Series with the Oriskany stratigraphically lying above the Heiderberg. The former consists of white to brown, partly calcareous, fossiliferous sandstone at the top and below. The Helderberg Formation is comprised of Keyser limestone at the base, Coeymans limestone in the middle and New Scotland limestone at the top. The limestone forms a major portion of the Helderberg and consists of a lower series of limestones, usually with modular layers, and an upper series of relatively shaley limestones. It usually ranges from 90 to 200 feet in thickness. The Coeymans limestone varies in thickness from 3 to 10 feet and ranges in character from a coarse Crinoidal limestone which is sandy in the lower part to a calcareous sandstone which usually contains chert. The New Scotland limestone consists of shale and impure limestone which contains white chert with a thin basal limestone, and ranges in thickness from 10 to 60 feet. Generally, a good water-bearing Formation, although the water is hard, highly mineralized, and generally unsuitable for most uses without extensive treatment.

Keyser, Tonoloway, Wills Creek, Bloomsburg and McKenzie Formations

These five Formations are of the Upper and Middle Silurian Series and outcrop in a narrow band along the entire length of the north side of Bald Eagle Mountain in Centre County. They are predominately thin bedded limestones with some sandstone in the middle Formations and some shale in the base layers.

Port Matilda Borough's and Howard Borough's public water supply wells draw from the Keyser-Tonoloway Formations, and Mount Eagle's public water supply is from the Wills Creek Formation.

Clinton Group and Tuscarora Formation

The Clinton Group and Tuscarora Formation are Members of the Lower Silurian Series which extend in a narrow band along the ridge of Bald Eagle Mountain. The Clinton Group is predominately made up of the Rose Hill Formation, a fossiliferous shale with some 'iron sandstones' and limestone. Quartzitic sandstone interbedded with shale lies above the Rose Hill Formation. The 'lower' Tuscarora Formation consists of a white to gray quartzitic sandstone.

Juniata, Bald Eagle and Reedsville Formations

These three Formations of the Upper Ordovician Series outcrop extensively in the southern portion of the County and in a narrow band along the southern side of Bald Eagle Mountain.

The younger Juniata Formation crops out in high, narrow valleys between crests of Tuscarora quartizite in the southeastern portion of the County. The Formation is comprised almost entirely of red or black shale and sandstone. The sandstones are usually fine-grained, micaceous and often cross-bedded.

Water is scarce, although sometimes found as hillside springs.

The middle Bald Eagle Formation occurs in a very narrow band of gray to greenish gray sandstone.

The older Reedsville Formation consists primarily of brown, greenish and black clayey to sandy shale, usually contains black shale in the lower portion, thin limestone beds at intervals, and gray sandstone at the top. A reliable source of water for domestic use sometimes with high iron content.

Coburn, Salona, Nealmont, Linden Hall, Benner, Hatter, and Loysburg Formations

These Formations of the Middle Ordovician Series lie above the Beekmantown Group and, generally, are found stratigraphically in the order of listing with the Coburn Formation the uppermost. All of the Formations are basically limestones with some shales found in the upper formations and some laminated dolomites in the bottom Loysburg Formation. The Linden Hall Formation, measuring up to 150 feet in thickness in the Nittany Valley, is the most economically important to Centre County as its upper Member, the Valentine is of an exceptionally pure limestone. Reported thicknesses of this Member range to 90 feet. It is being extracted at several locations in the County for flux, cement, lime, aggregate, and roadstone as well as for the manufacture of glass, filler, and whitening. The Oak Hall and Centre Hall Members of the Nealmont Formation have been quarried for flux stone in the past.

Beekmantown Group

The Beekmantown Group of the Lower Ordovician Series crops out over a large area in the center portion of the County and includes Lark dolomite, Stonehenge limestone, Nittany dolomite, Axemann limestone and Bellefonte dolomite. The Larke dolomite consists primarily of thick-bedded, coarse, crystalline, dark blue dolomite and is approximately 250 feet thick although it may be absent locally. The Stonehenge limestone is comprised of relatively pure, blue limestone but contains some magnesian limestone and locally dark blue dolomite. It is 702 feet thick near Bellefonte.

The Nittany dolomite ranges in thickness from 1,000 to 1,250 feet and consists almost entirely of light gray or blue-gray, fine-grained dolomite which occurs in layers as thick as 2 feet. The Axemann limestone is a relatively pure, thin-bedded, dark blue-gray limestone which contains only a few thin layers of dolomite and ranges in thickness from 50 to 500 feet. The Bellefonte dolomite consists primarily of dark, fine-grained dolomite. It may be either thin, or thick-bedded and includes a few light gray beds, a little dove-colored limestone and some chert. It also contains a sandstone bed which reaches 15 feet in thickness in some areas but is absent in others. The dolomite is approximately 2,200 feet in thickness near Bellefonte. It is assumed that the white kaolinite clay deposit being mined near Stormstown is in the Beekmantown Group. Moderately hard water is found in good supply and oftentimes surface springs of ample flow are encountered.

Gatesburg Formation

The Gatesburg Formation of the Middle and Upper Cambrian Series is characterized by a thick soil and overburden mantle of residual sand and sandstone boulders and is comprised principally of thick-bedded, coarse, crystalline, blue dolomite with some thin-bedded, fine-grained dolomite. The Formation consists of many intercollated layers of sandstone and quartzite. Large supplies of water are found but usually at depths up to 300 and more feet. Nittany Water Company, Rock Springs Water Company, Upper Halfmmon Water Company and the Walker Township Water Association have public water supply wells in this Formation.

The Mines Member of the Gatesburg Formation consists chiefly of coarse-grained, gray dolomite. A good supply of water for domestic use is usually found.

CARBONATE GEOLOGY

Carbonate rocks are made up of varying quantities of the minerals Calcuim Carbonate (limestone) and Magnesium Carbonate (dolomite).

Because carbonate rocks are soluble in water, underground rock is dissolved to leave channels and conduits. These underground waterways

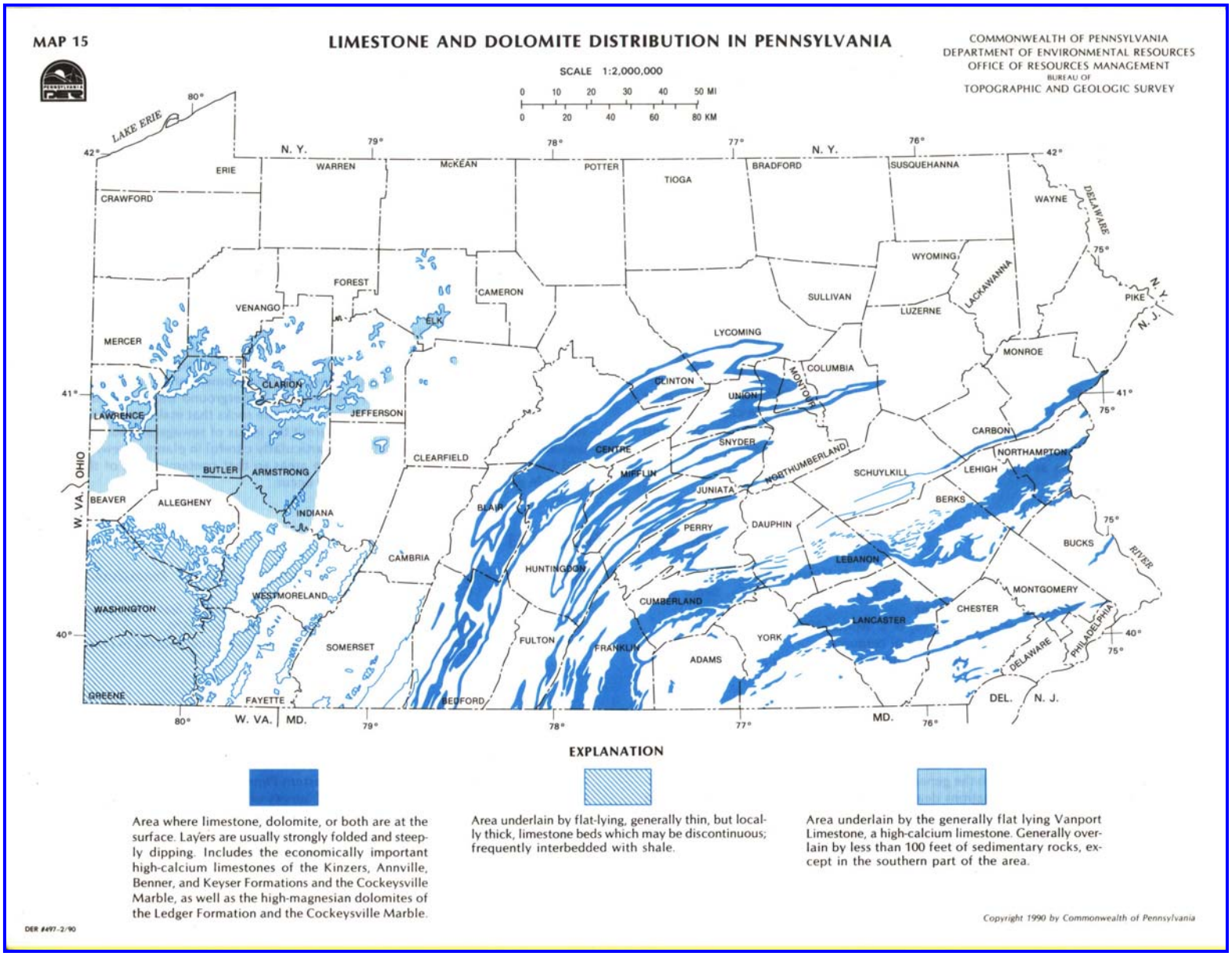


Figure 2: Limestone and Dolomite Distribution in Pennsylvania (Legend Notation for the solid blue area: Area where limestone, dolomite, or both are at the surface. Layers are usually strongly folded and steeply dipping…)

provide for flows and reserves that result in high potential for community groundwater reserves. A further benefit is that the high yield of groundwater in carbonate areas augments stream flow which enables relatively stable surface flow even during dry periods.

The weathering of carbonate rocks has created highly productive agricultural soils. These rich soils also support diverse and productive wildlife habitats on land and in streams. One other benefit of these soils is that they provide good drainage which is a plus for development; however, it also presents limitations with respect to development potential.

One limitation of carbonate areas is the possibility of collapse into underground voids. The implications this has on construction are obvious. There are many examples of homes that have "settled" and sinkholes (Figure 3) or caves that have opened in limestone valleys.

The problem can be largely overcome by thoroughly investigating sites prior to construction. If unstable geology is found, the foundation should be secured to sound material or perhaps a new site should be found.

A second limitation stems from the possibility of groundwater contamination in carbonate areas. Runoff that carries pollution with it in carbonate areas quickly finds its way into the groundwater because of rapid percolation through sinkholes or through a shallow soil cover. Once the pollution is introduced to the groundwater, it can quickly spread through the underground solution channels.

Locally high groundwater tables in carbonate areas will, at times of heavy precipitation or spring snow melts, drain into shallow depressions causing flooding in those depressions. The high water table can also cause problems in areas with homes or structures by weakening the foundations.

Figure 3: Sinkhole development in Gill Field (Ferguson Township) at the intersection of West College Avenue, State Route 26 South, and Science Park Road

MINERAL RESOURCES

Take what you can use and let the rest go by.
Ken Kesey, Author, Quote on the Earth

Centre County's landscape has changed over the years to meet the local, state and national demands for mineral resources. Surface coal mining, limestone and sandstone quarry operations, clay and shale pits have all contributed to this change in topography.

Recovering mineral resources has been an important economic activity in Centre County for some time. Iron ore was first discovered in 1784. The first iron furnace began operation at Centre Furnace in 1792. By 1826 there were 19 furnaces or forges in the County and Centre County was part of the leading iron producing area in the United States.

The iron industry lost its locally prominent position by the mid-19th century; however, due to high transportation costs, general depletion of iron ore fields, less expensive iron from England and competition from Pittsburgh. It started a long decline which ended shortly after the turn of the century when iron production ceased. Limestone and coal extraction soon became the major mineral activities to replace the ironworks.

By 1975, limestone extracting industries employed about 500 persons in the County, while bituminous coal companies employed over 400 persons.

A newly tapped mineral resource in Centre County is natural gas. The first production well was drilled in 1952. Since then, development of natural gas wells in Centre County continues at a steady pace.

According to a recent article in PA Geotech entitled, "Pennsylvania-Truly a Keystone State[2]," the Commonwealth's mineral industries produced before the 1900s one-half of the total mineral wealth of the United States. Today, Pennsylvania produces less than 4% of the US total. The Commonwealth, however, ranks 11th in the Nation for total nonfuel mineral production and ranks 2nd for crushed stone, 3rd for cement and 6th for lime production.

In 2001, Centre County's mineral resource industry employed approximately 207 employees; however, this industry saw a loss of 301 jobs from 1990 to 2001. This drop in employment was due to the decline in the coal mining industry in the County; however, employment in the limestone industry increased over the last decade. As of 2001, mining made up one-tenth of one percent of our County's employment.[3]

Comparing Centre County to the rest of the state with respect to mineral extraction, our County ranks fourteenth out of the 67 counties. This ranking is based on best available data collected by the Pennsylvania Department of Environmental Protection for their 2001 Annual Mining Report. Figure 4 shows the production statistics for 2001.

The PADEP staff point out the data are incomplete since some producers failed to report total production statistics for their operations. (Data for 2002 will be released during the Summer of 2003 and will be the most complete compilation of data on mining operations in the state. More accurate information on Centre County's operations will be made available through this report.) It is important to note that the operators are not required to submit information on the type or grade of the resource mined which is considered proprietary information.

The challenge with respect to mineral resources extraction is how much of the resource should be taken out of the ground to meet current and future demands and how do we plan to meet those needs while minimizing conflicts with neighboring communities and at the same time protecting the environment. Mineral extraction will continue to be a part of our landscape; therefore, it is important that we are thoughtful in planning for the 'reasonable expansion' of these operations. The recommendations for Mineral Resources are intended to meet this challenge.

[2] PA GEOTECH, Volume XIII, No. 2, May 2003, Sam Berkeheiser, PG, Assistant State Geologist, Author

[3] Steve Smith and Martin Shields, *Centre County Comprehensive Plan Update Economic Analysis, 2002*, Penn State University's College of Agricultural Economics

Year	Mineral Resource	Total (Tons) Production	Total Employees
2001	Sandstone	563,033	21
2001	Sandstone/Topsoil	250	1
2001	Shale	4,116	7
2001	Clay and Shale	1,000	1
2001	Clay	150	1
2001	Coal	63,922	7
2001	Limestone	4,474,641	169

Figure 4: Centre County Production Statistics-2001

Centre County's Black Diamond-Coal

Coal, Centre County's black diamond, is defined as, "…a rock composed of thermally altered and highly compressed plant material that grew millions of years ago in swamps and then was buried under great thicknesses of sand and mud."[4] This process perpetuated itself over time resulting in layers of coal in between shale, sandstone and limestone.

Bituminous (soft) coal reserves are found in Centre County in an arc extending from the southwest portion of Rush Township through Burnside and Snow Shoe Townships to north central Curtin Township.[5] The map in Appendix A-1 shows the location of coal beds in Centre County.

There are six coal bearing beds in Centre County. These strata range in thickness and quality which are listed in Figure 5.

Strata	Average Thickness	Quality
Upper Freeport	39"	Good
Lower Freeport	39"	Good
Upper Kittanning	36"	Very good
Middle Kittanning	20"	Less pure and locally thin
Lower Kittanning	39"	Excellent
Brookville-Clarion	39"	Poor

Figure 5: Coal Bearing Beds

History of Coal in Centre County-Beech Creek Watershed

"In 1819 coal was discovered by a hunting party near the Snow Shoe area of the watershed. At this time homes were heated with wood and coal mining was limited to local use. This all changed in 1859 when the Bellefonte and Snow Shoe Railroad was completed. Now trainloads of coal and timber could be moved to markets in the East. Eventually, the New York Central lines were connected and coal mining mushroomed. Mining practices at this time involved digging tunnels or shafts that sometimes sloped sharply downward for several hundred feet.

Many mining villages were scattered over the coal bearing regions of the watershed and local coal industries flourished. For example, in the 1880's about 100 coke ovens were located in the Clarence area. The coal was brought in by train and made into coke, which had a ready market in Pittsburgh as a fuel for the iron furnaces.

Deep mining in the watershed has ceased long ago and the mines were abandoned. Today the names of the mining villages are no more than memories."

Beech Creek Watershed Association
http://mywebpage.netscape.com/bcwasite/

[4] *Coal in Pennsylvania,* Pennsylvania Department of Conservation and Natural Resources, Bureau of Topographic and Geologic Survey, Fourth Series, Harrisburg, 2002, page 4

[5] *Centre County 1976 Land Use/Open Space Plan Evaluation & Policies,* Centre County Planning Commission

Year	Total Production	Underground Production	Surface Production	Underground Employees	Surface Employees	Total Employees
1990	1,012,012	718,563	293,449	246	85	331
2000	38,890	0	38,890	0	8	8

Figure 6: Centre County Coal Production 1990 and 2000

Bituminous Coal production dates back to the early 19th century. By 1917, the state of Pennsylvania out-produced most of the world.[6] The first records of coal production in Centre County show that 916,112 tons were mined in 1925. The height of coal production in Centre County was in 1980 where 1, 817, 580 tons were extracted from the ground. [7] The table in Figure 6 shows a ten-year comparison of coal production in Centre County.[8] As of 2000, 90 million tons of coal reserves remain in the County.[9]

Originally, coal was extracted through a deep mining process; however, with advances in technology the practice of surface mining became more prevalent. Today, Centre County's coal is recovered through surface mining operations.

Coal mining has not been without consequences. Acid mine drainage, subsidence, dangerous high walls, and contamination of drinking water supplies are just a few of the more serious problems associated with this mineral extraction activity. Programs are in place to regulate and/or address mining operations as noted in Figure 7.

The enactment of the Surface Mining Control and Reclamation Act in 1977 was a turning point nationwide for how coal industries operated with respect to mined land reclamation.

Environmental Laws and Programs- Coal Mining	
Surface Mining Conservation and Reclamation Act	Requires coal operators to register mines, post a bond, cover exposed coal, and revegetate the land. It was amended in 1992 to provide incentives for remining.
Clean Streams Law	Protects streams from pollution including acid mine drainage.
Anthracite and Bituminous Coal Mine Subsidence Fund	An insurance program established to cover damages from deep mine operations causing subsidence.
Bituminous Mine Subsidence and Land Conservation Act	Protects structures from the effects of deep mining bituminous coal.
Operation Scarlift	Bond issue established to finance the reclamation of abandoned mined lands. Resulted in the development of planning studies. Monies were not available through this program for funding the projects identified.
Coal Refuse Disposal Act	Helps control pollution from coal refuse piles.
Surface Mining Control and Reclamation Act (Federal)	Requires all active coal operators to return mined lands to original contour and post bonds to guarantee that the work will be done within a set time period. This Act was modeled after Pennsylvania's Surface Mining Conservation and Reclamation Act of 1971. Pennsylvania achieved primacy in 1982.

Figure 7: Environmental Laws to Regulate Coal Mining

[6] *"Paying the Price, Pennsylvania's Rich Legacy of Coal Leaves Cleanup Problems for Today", Pennsylvania Township News*, December 1996, page 11

[7] *Bituminous Coal-Total Production by County,* Pennsylvania Department of Protection's Website

[8] *Pennsylvania Coal Data 1991, and Pennsylvania Coal Data 2001*, Pennsylvania Coal Industry

[9] Ibid

Pennsylvania's program adopted in 1945 served as a model for the Federal Act. The Federal government established through this legislation that lands mined and abandoned prior to the passage of this Act were eligible for financial assistance and that lands mined after August 1977 must be reclaimed. Monies for reclamation

are provided for through two funding sources: Abandoned Mine Land (AML) Trust Fund (Title IV of the Surface Mining Control and Reclamation Act of 1977) and Forfeited Reclamation Bonds.

Coal operators of active mines are required to pay 35 cents per ton for surface mined coal and 15 cents per ton for deep mined coal. These monies are put into a Trust Fund. Fifty percent of the funds are directed back to the states for addressing problems that resulted from pre-August 3, 1977 mining. Priorities are established for funding projects and are determined based on emergencies, protection from extreme danger and from adverse effects. Ranking the highest are emergencies, Priority 1 and Priority 2 projects as defined in Figure 8.

PRIORITIES	
EMERGENCIES	An event that occurs suddenly, is life-threatening and demands attention.
PRIORITY 1	Protection of public health, safety and general welfare and property from extreme danger of adverse effects of coal mining practices.
PRIORITY 2	Protection of public health, safety and general welfare from adverse effects of coal mining practices.

Figure 8: Abandoned Mine Reclamation Fund Project Priorities

The remaining fifty percent is allocated to the Federal Office of Surface Mining; however, twenty percent goes back to the states based on historical coal production. Another twenty percent goes towards emergency reclamation projects overseen by the Federal government and the remaining ten percent goes to the Rural Abandoned Mine Program (RAMP) which is administered by the US Department of Agriculture.

The Surface Mining Control Reclamation Act is scheduled to expire in 2004 leaving many high priority sites unfunded. The Federal Government is holding over $53 million in the Fund for the state of Pennsylvania.

The other source of monies is from forfeited bonds when mining operators fail to reclaim a site. Upon forfeiture, the Pennsylvania Department of Environmental Protection's Bureau of Abandoned Mine Reclamation steps in and takes responsibility for reclamation of the land. [10]

As of March 2002, there were 121 Abandoned Mine Land sites in Centre County with 709 unreclaimed AML features.[11] These abandoned mine lands encompass a total of 5,866 acres.

The inventory in Appendix A-2 shows the types of features that have priority status. One recent example of a reclamation project in Centre County is the proposed backfilling of a dangerous highwall that is approximately 1200 feet long by 30 to 40 feet high.[12] This project area is located just northeast of the village of Casanova, Rush Township. Once completed, 7.6 acres of abandoned strip mine will be reclaimed as well as safety concerns addressed.

Acid Mine Drainage (AMD)

Acid Mine Drainage is the "drainage flowing from or caused by surface mining, deep mining or coal refuse piles that is typically highly acidic with elevated levels of dissolved metals." [13] Typically, when water comes in contact with oxygen and pyrite in coal, refuse or overburden of a mining operation the result is high acidity and dissolved metals.

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[10] *Paying the Price, Pennsylvania's Rich Legacy of Coal Leaves Cleanup Problems for Today*, Pennsylvania Township News, December 1996, page 16

[11] *Abandoned Mine Reclamation in Pennsylvania, The Abandoned Mine Reclamation Fund (Watershed Fact Pack), Partnerships, and Future Challenges*, Pennsylvania Organization for Watersheds & Rivers, page 9

[12] Pennsylvania Act 14 of 1984 Notification, Pennsylvania Department of Environmental Protection' application for a General NPDES Permit, April 21, 2003

[13] *The Science of Acid Mine Drainage and Passive Treatment*, Pennsylvania Department of Environmental Protection, Bureau of Abandoned Mine Reclamation, page 2

Major streams and tributaries in Centre County have been rendered lifeless due to this pervasive problem (See Appendeix A-3, Map of Fisheries Impacted by Acid Mine Drainage). Moshannon and Beech Creeks are both tainted red and void of most life with the exception of mosquitoes and a few plants. Efforts are underway by local watershed and sportsmen associations to remediate this never-ending problem.

With respect to Moshannon Creek, the entire reach is polluted, with the exception of its extreme headwaters. This stream contributes approximately 130,000 pounds per day of acid to the West Branch of the Susquehanna.[14] The water has a pH similar to vinegar.

In the early 1970s, an extensive study was conducted of the Moshannon Creek Watershed and was referred to as the Clearfield Creek & Moshannon Creek Mine Drainage Pollution Abatement Project under Operation Scarlift. The emphasis of the study was to attain the greatest amount of abatement for the lowest cost.

The study focused on subbasins of the watershed which were determined to be 'hot'. Abatement plans were developed for each of these subareas. Generally, the plans called for regrading, adding limestone and revegetating abandoned sites.

The studies resulting from Operation Scarlift are considered planning documents only. No additional monies were made available for continuing this work.

Restoring Moshannon Creek and its tributaries is the primary objective of the Moshannon Creek Watershed Coalition. Accomplishing this objective is being done by (1) assessing the stream (2) locating points of acid mine discharge, and (3) testing the waters for pH and metals. Once the 'snapshot' assessment is completed then an implementation plan will be developed for treating the mine drainage. The Centre County Conservation District is actively working with the Moshannon Creek Watershed Coalition in conducting the assessment.

More specific activities designed to restore water quality in this watershed are (1) submission of a grant application to treat Trout Run, a tributary of Moshannon Creek, and (2) construction of a passive treatment system, Chiller Seeps. The proposed Trout Run project will be supported by a local Boy Scout troop which has volunteered to conduct water quality monitoring along this tributary. The latter project was lead by the Wood Duck Chapter of Trout Unlimited and funded through the Growing Greener Grant Program.

CHILLER SEEPS- Cold Stream

Project of the Wood Duck Chapter of Trout Unlimited, Passive Treatment System for Acid Mine Drainage

Treated acid mine

To the left of the photograph (Above) are the natural seeps flowing into a drainage ditch. The ditch was designed to capture the acid mine drainage flowing from the seeps. The source of the pollution is an abandoned deep mine.

[14] Moshannon Creek Watershed Coalition Brochure

The ditch collects and channels the polluted waters to a series of basins designed to passively treat the mine drainage.

This photograph shows the third in the series of basins that acts as a settling basin. Metals in the acid mine drainage are separated out from the water due to an elevated pH. This is the result of the prior basin (not shown) neutralizing the water by raising the pH. The pH of the acid mine drainage at the source averages around 3. Metals stay dissolved in acidic water due to its lower pH. Once the pH is elevated to around 5 the metals separate out from the water and are collected in the basin as shown above.

Above are the next three basins which also serve to settle out the metals and maintain a higher pH. The water is then discharged into Cold Stream with an approximate pH of 5+. Effectiveness of passive treatment systems for treating acid mine drainage was studied by the Department of Biology of Clarion University. As reported in the Center for Rural Pennsylvania's March/April 2003 newsletter, "The study found that passive treatment systems have the potential to treat AMD successfully, since most of the systems in the study area helped to significantly reduce contaminants." The study area was the Mill Creek Watershed in Clarion and Jefferson Counties.

Similar to the Moshannon, Beech Creek has experienced a similar fate as a result of close to 160 years of abandoned mine drainage discharging into this watershed. The Beech Creek Watershed Association is conducting a comprehensive assessment of the watershed.

Another significant project of this Watershed Association is addressing the acid discharge to Jonathan Run, a tributary to the South Fork of Beech Creek (Figure 9). The discharge stems from the construction of I-80 whereby excess acid-bearing road material was deposited in a wetland area located at the headwaters to Jonathan Run. The Beech Creek Watershed Association was awarded a Growing Greener Grant for the reclamation of Jonathan Run.

Figure 9: Jonathan Run Reclamation Project

As noted in the Surface Water section of the Plan, Beech and Moshannon Creeks are streams recommended for the Federal Clean Water Act's 303 (d) listing. (Section 303(s) requires states to list all impaired waters not supporting their designated uses even after appropriate and required water pollution control technologies have been applied.[15]) Assessments of these streams determined that the source of impairment is acid mine drainage.

[15] *The Clean Water Act and its Requirements*, Springs & Sinks Special Edition, November 2002, Page 7

Once the stream assessments are completed and a listing of impaired streams compiled, the Pennsylvania Department of Environmental Protection (PADEP) is required to calculate the Total Maximum Daily Loads (TMDLs) for the listed waters. Total Maximum Daily Load is " the maximum amount of pollutant that a water body can receive and still meet water quality standards."[16]

Pending Federal rulemaking would require that remediation plans be put in place in order to meet TMDLs. This rulemaking is referred to as the 'Watershed Rule'. The costs associated with developing a remediation plan would be paid for with available grant dollars.

To date, TMDLs have not been calculated for the impaired streams of Centre County. PADEP has approximately eight to thirteen years to calculate the TMDLs for the listed streams once the assessments have been completed.

Another treatment method utilized in Centre County is by chemical means. This method is being utilized by the Halfway Coal Mine in Kato, Snow Shoe Township for treating its acid mine drainage.

Treated acid mine drainage also provides potential opportunities for other uses. The former Rushton Mine owned by Pennsylvania Mines (Pennsylvania Power and Light) has a water treatment plant on site. The mine drainage is treated to high water quality standards, and the plant discharges 5 million gallons per day of this water into Moshannon Creek. One potential reuse identified for this treated water is a fish hatchery.

Biosolids

Reclaiming land to its original contour as required by law restores the landscape, protects the watershed from release of pollutants and provides opportunities for reuse of the land. The land application of biosolids regenerate the soil layer at mine sites as well as establishing vegetation. Biosolids are 'nutrient rich organic materials derived from treated wastewater solids (sewage sludge and residential septage) that have been stabilized, meet specific processing and quality criteria and are suitable for land application'.[17] The PADEP is the permitting agency for biosolids application. Coal companies apply for permits to apply bio-solids as a soil additive.

Rush and Burnside Townships have both adopted ordinances requiring a tipping fee for any sludge applied for mine reclamation purposes within their municipal jurisdictions. The monies collected from the tipping fees are to be used to cover the costs of testing of trace elements. The intent of testing is to protect the health, safety and welfare of the township residents by monitoring the sludge application. The Rush Township ordinance is currently being challenged in court.

Unsuitable for Mining Designation

Title 25, Environmental Protection, of the Pennsylvania Code protects two surface water basins in Centre County by prohibiting surface mineral extraction of coal reserves. Chapter 86, Surface and Underground Coal Mining, designates the surface water drainage basin of Upper Cold Stream upstream from the mouth of Tomtit Run and the surface water drainage basin of Black Bear Run as **Areas Unsuitable for Mining (UFM)**.

This designation is granted in the form of rulemaking by the Pennsylvania Environmental Quality Board (EQB) and protects areas 'where surface mining could cause significant damage to or long term losses of important environmental features'[18]. The basis for Upper Cold Stream and Black Bear Run UFM designations is that both are High Quality watersheds.

[16] *Overview of Current Total Maximum Daily Load-TMDL-Program and Regulations*, US Environmental Protection Agency (Source: US Environmental Protection Agency's Website)

[17] Biosolids, Frequently asked questions about the land application of biosolids in Pennsylvania, Pennsylvania Department of Environmental Protection

[18] *Areas Unsuitable for Mining Program-Summary*, Pennsylvania Department of Environmental Protection (Source: PADEP Website)

Coal's Future

The PADEP has taken the position that it will work with the coal industry by making environmental protection 'an engine of, not an impediment to, economic growth'[19]. The state plans to develop and implement initiatives which would boost the coal industry.

In Centre County, the coal industry's production has dropped considerably. Today, small operations continue to extract the County's bituminous coal resources in small quantities. The coal extracted is mainly used for heat production. Overall, coal extraction does not seem to have much of a future in Centre County largely due to its high sulfur content.

As required by a Federal mandate, coal operations are inspected monthly. The PADEP continues to closely monitor these operations and their impact on the environment.

CLAY

Clay is an 'earthy, extremely fine-grained sediment or soft rock composed primarily of clay-size particles, having high plasticity and a considerable content of clay minerals.'[20]

There are two types of clay in Centre County. One is the soft plastic clay that is associated with coal-bearing rock strata and also can be found in the Gatesburg Formation as a white , kaolinite deposit. The white kaolinite clay is suitable as a cement agent for fire clay, brick, and has a limited use in the manufacture of paper. One of the most recent white clay mines was located in the Beekmantown Formation near Stormstown.

The other type of clay found in Centre County is flint clay. The flint clay is found below the Allegheny Group rock strata and is specifically associated with the Mercer Horizon below the Brookville coal bed. This clay is called the fire clay and is used in the manufacture of high grade refractory materials. The locations of the Mercer clays and the white clays are identified on the map in Appendix A-1. Mercer clay seams have an average thickness of six feet while the Brookville clay seams average three to five feet in thickness.[21] Areas identified with Mercer clay reserves are in Rush, Snow Shoe and Curtin Townships.

The Pennsylvania Department of Environmental Protection's (PADEP's) 2001 Annual Report for Mining listed only one clay operation in Centre

History of Clay

Early settlers in Centre County mined clay for pottery. Potteries were established in Woodward, Gatesburg and Milesburg.

One of the primary uses of Centre County was brick making although the earliest bricks used for building were imported into the County. The first brick making occurred on the property of the building to be built. For example, the farm house for the former Klinger Farms Dairy in College Township was built in 1820 with bricks made and fired on the farm. Other houses in the County were also built in this manner including several of the early buildings on Penn State's campus.

Around the time of the Civil War, brick plants were opened in areas of the County. Brick plants were located in Coleville, Wingate, Milesburg, Howard, Port Matilda, Snow Shoe, Orviston and Monument. (Map of Brick Plants and Potteries)

In 1866, a brick works was started in Sandy Ridge for the purpose of making fire brick. These bricks were used in stoves, furnaces, fireplaces and steel furnaces.

The brick plants in Centre County have since closed due to the high cost of transporting the bricks and aging infrastructure of the plants.

The History of Centre County-The County In Which We Live by J. Marvin Lee. 1965. Page 64

[19] *McGinty Stresses Need to Balance Environment, Economy*, Weekly DEP Newsletter, May 2, 2003

[20] Dictionary of Geological Terms Third Edition, The American Geological Institute, 1984, page 91

[21] *The Geology of Pennsylvania*, Pennsylvania Department of Conservation and Natural Resources Bureau of Topographic and Geologic Survey, 1999, page 609

Map of brick and potteries

County, Martin L. Koleno Mine in Snow Shoe Township. The report shows that a total of 150 tons were extracted from this pit by one employee working a total of ten hours during this annual reporting period. Clay extracted from the Koleno clay pit is used for driveway fill.

In comparison, there were two active clay mines in Centre County in 1969. One, operated by Harbison Walker Refractory Company, produced approximately 3,500 tons of kaolinite type clay annually from a mine near Stormstown. All of this clay was shipped out of the County and used in the manufacturing of silica and fire brick. The second mine, which was located about four miles north of Snow Shoe, supplied the France Refractories Company with a non-Mercer clay, used in the manufacturing of brick and structural tile.[22]

The primary reason for the minor extent of clay mining in the County is that higher-quality sources are now mined in other states. Higher quality clays are sought by refractories for making fire bricks.

Pennsylvania clays hold potential as impermeable liners for landfills or for wetland mitigation. Clays used for these purposes are typically mined on-site or in close proximity to a landfill or wetland and do not need to have any specific chemical properties.

Brick-making still occurs in Centre County. Premier Refractories International, formerly the J.H. France Refractory, located in Snow Shoe manufactures fire bricks for the steel industry. No Centre County clays are used as part of their manufacturing processes. Premier Refractories employs 75-100 persons.

Local artisans use Centre County clay, found in the Gatesburg Formation and the underclay of the coal seams, for pottery and sculpting.

Shale

[22] *Centre County Pennsylvania, Comprehensive Plan 1970, Phase 1, Background Studies*, Centre County Planning Commission, Clifton E. Rodgers & Associates-Consultants, Page 3-37

SHALE

Shale is a fine-grained sedimentary rock, formed by the compaction of clay, silt, or mud. It may be red, brown, black, or gray.[23]

Shale is quarried in a few locations in the Centre County. The average extraction rate in 2001 was an average of 1,000 plus tons per shale operation. The general use of shale is 'borrow and fill' which means that it is extracted from one location to be used as fill in another location.

Extraction of shale is regulated by the PADEP. Small producers of nonfuel minerals must apply for a surface mining permit and are inspected annually.

SANDSTONE

Sandstone is a sedimentary rock composed of grains of sand set in a matrix of silt or clay and more or less firmly united by a cementing material.[24]

Sandstone is considered a resistant rock compared to limestone. Erosion that took place over a million years ago formed our valleys leaving ridges of sandstone as part of a mountain-building process.

Sandstone is quarried in Centre County in Rush, Howard, Snow Shoe and Liberty Townships and soon to be quarried in Halfmoon and Worth Townships as noted on the map in Appendix A-1.

The two largest operations are Sandy Ridge in Rush Township just south of Osceola Mills and the proposed Port Matilda Quarry in Halfmoon and Worth Townships. In 2001, Glenn O. Hawbaker Inc. extracted over 500,000 tons of sandstone from their Sandy Ridge operation. Eleven persons were employed at this quarry during 2001. Hawbaker also owns the Port Matilda Quarry which is permitted for 169.58 acres with 68.74 permitted for mineral removal.

[23] Dictionary of Geological Terms, Third Edition, The American Geological Institute, 1984, Page 460

[24] Ibid, Page 446

Sandstone is abundant in Centre County; however, extraction of this resource is not without its challenges. One challenge is permitting. Mountains are headwaters to high quality streams. Protection of these headwaters is critical and may conflict with mining activities. The other challenge is local regulation. One classic example is Spring Township's ban on sandstone quarrying atop Mount Nittany. After a six-year legal battle, the Commonwealth Court ruled that the zoning ordinance's exclusion of quarrying from the township's Forest District "is substantially related to the health, safety and general welfare of the community, there is no unconstitutional 'taking' here."[25] Other municipalities also have adopted regulations for mineral extraction activities in order to protect the natural resources as well as impacts to neighboring communities.

In 2003, Two Rock Stone Quarry in Howard Township proposed an expansion of its existing sandstone operation. Based on the PADEP's 2001 Annual Report for Mining, Two Rock Stone mines less than 2,000 tons per year. As a result of this operation's activities, neighboring residents experienced erosion and sedimentation pollution on their properties and impacts to their domestic water supplies. In response to these concerns, Two Stone Quarry withdrew its application for the expansion.

These operations are permitted and regulated as nonfuel surface mining operations by the PADEP. Federal mine safety regulations also apply.

NATURAL GAS

As with coal, natural gas, a mixture of hydrocarbons that occurs with petroleum deposits[26] , is one of Centre County's other economic resources that has been tapped for home, commercial and industrial use.

In Pennsylvania, natural gas was not considered a viable resource until the late 1800s. Once the infrastructure and the utility companies were in place, there was a rise in natural gas well exploration and development with the majority of the wells in located in the western part of the state.

Initially, shallow wells were developed. These wells generally range in depth from 500 to 5,000 feet depending on the geologic setting. Exploitation of shallow wells and advances in technology lead to gas exploration companies probing below the depths of the shallow wells to develop deep wells.

In Centre County, natural gas resources may be found in the northwestern and western portions of the County as shown on the map in Figure 11. As noted on the map, there are three smaller deep gas fields in close proximity to the shallow gas fields. A gas field is a subsurface accumulation of natural gas that will yield gas in economic quantities and is on a single geologic or closely related feature.[27] Shale, sandstone and minor coal formations are where natural gas may be found. Gas wells in these fields range in depth from 4,000 to 5,000 feet with the production occurring from 2,500 to 5,000 feet. The deep wells are 10,000 feet or more in depth.

Estimates of probable[28] and possible[29] resources in Centre County are less than 100 billion cubic feet.[30]

The Pennsylvania Department of Environmental Protection's (PADEP) records show that the first production well developed in Centre County was in 1952 and was located in Union Township.

[25] "Township quarry ban upheld again," by Mike Joseph, *Centre Daily Times*, November 28, 2001
[26] Natural Gas definition, Webster's II New College Dictionary, 1999

[27] *Dictionary of Geological Terms*, *Third Edition*, The American Geological Institute, 1984, Page 202
[28] Probable is defined as resources that are believed discoverable and recoverable without significant advances over discovery and/or recovery techniques. *The Geology of Pennsylvania*, Pennsylvania Department of Conservation and Natural Resources, 1999, Page 531
[29] Possible is defined as resources having a lesser degree of assurance of discovery and recovery, chiefly because of sparse data and information. Ibid. Page 531
[30] *The Geology of Pennsylvania*, Pennsylvania Department of Conservation and Natural Resources, 1999

The first permitted well was developed in Marion Township in 1963.

REPORTED PRODUCTION FOR CENTRE COUNTY		
Production Year	Natural Gas (MCF)*	Brine (Bbl)**
1994	3,383,791	39,151
1995	2,800,059	40,709
1996	2,285,264	33,977
1997	2,021,639	33,001
1998	2,028,003	21,704

FIGURE10: Production Statistics (Source: Pennsylvania Department of Conservation and Natural Resources, PA Geological Survey)

Current production statistics for natural gas are provided in Figure 10. It is important to note that production statistics are confidential for a five-year period; aggregate statistics by county have been compiled for the years 1994 through 1998 and are listed above.

Natural Gas Regulation

The Oil and Gas Act of 1984 was enacted to provide regulatory requirements for the drilling and operation of oil and gas wells. Under this Act, permits issued by the Pennsylvania Department of Environmental Protection's Bureau of Oil and Gas Management (Pittsburgh Office) are required prior to development of any new gas well. Operators must identify the proposed location of the well, proximity to coal seams, distance from surface waters and waste management and disposal methods for the well. If no adverse impacts will result from the well then the Department will issue the permit. Surface owners and coal mine operators are given an opportunity to file an objection to the permit application.

Amendments to this Act were approved in 1992, allowing PADEP to designate and plug abandoned wells, or orphan wells. Orphan well status exempts landowners, leaseholders, and well operators from the obligation to plug such wells on their properties, provided that they received no economic benefit from the well after April 1979. According to PADEP's records, there are no designated orphan wells in Centre County.

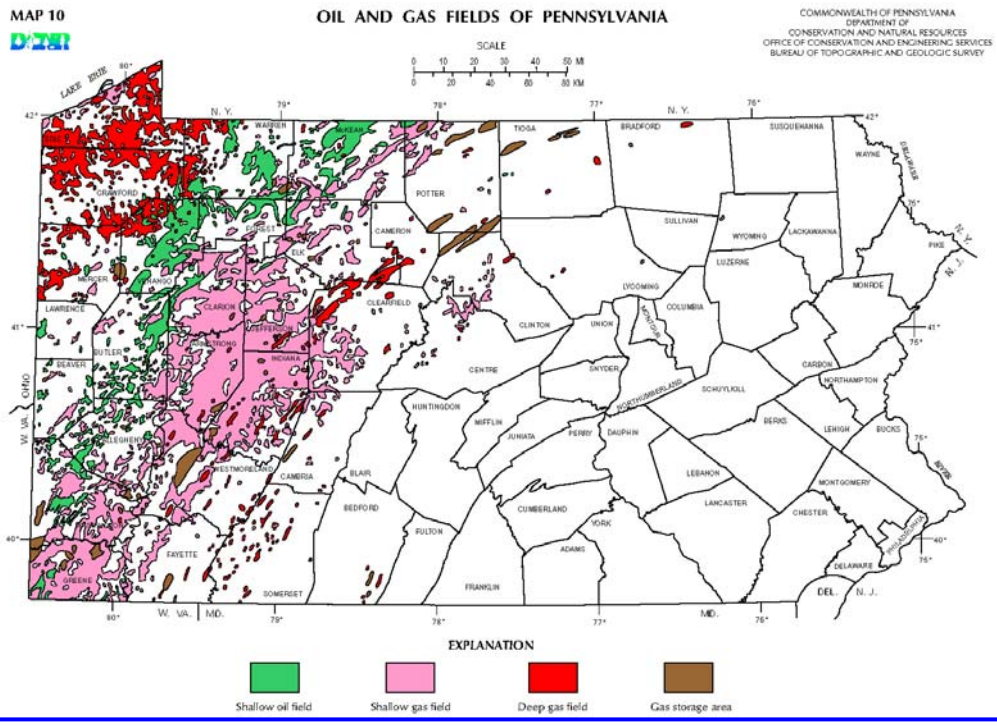


Figure 11: Map of Gas and Oil Fields in Pennsylvania

Bonding is also a requirement of the permit application. The bond would ensure that the operator properly reclaims the well site, properly plugs the well and addresses any water supply problem that the gas well activity may have caused.

Developed wells must be registered with the state. The map in Appendix A-1 shows gas well development in Centre County.

Brine

One of the by-products of gas well drilling is the production of brine. Brine is naturally found in deep subsurface formations and is typically produced along with oil and gas. The PADEP has been working cooperatively with the industry to develop beneficial reuse methods for brine. One beneficial reuse of brine is dust suppressant. Operators must get the approval of the PADEP for this application.

Traditionally, brine is contained on site in fiberglass tanks and then transported to an approved disposal facility. Approved facilities include brine treatment facilities and municipal wastewater treatment facilities. The only municipal facility in Centre County that accepts a very small amount of brine is the Bellefonte Sewage Treatment Facility. Brine from the County's natural gas wells is transported to facilities outside of the County. PADEP's data base does not provide information on the disposal locations for brine that it disposed outside of the County.

Permitting of gas wells as it relates to brine or natural gas takes into consideration the proximity of the well to domestic and public water supplies. The permitee, as part of the application, is asked to identify all water supplies within 1,000 feet of the proposed well. There is a 200 feet isolation distance from a water supply unless a waiver is granted. If a water supply is contaminated then the well operator is required to replace the source as provided for by the Oil and Gas Act. In order to prevent contamination from occurring, the well driller steel cases the well and cements the area between the casing and the borehole drilled for the well. The depth of the casing and cemented depth is determined by the depth of the fresh groundwater source.

State leases and state forest land

In August of 2002, the Commonwealth of Pennsylvania held a drilling-rights auction for natural gas leases on state forest land. The drilling rights up for bid were on state forest lands in Tioga, Potter, Cameron and Fayette Counties. No mineral leases were made available for Centre County's forest lands; however, gas drilling does occur on state lands where there are private holdings of the mineral rights. A good percentage of the natural gas wells are located on state forest lands through these holdings. Lessees of mineral rights located in state forests have the right to drill for natural gas.

As noted in the Forest Resources section of this Plan, oil and gas production is a growing concern on forested lands. Roads are constructed for production, creating threats to remote and natural areas. Degradation of wildlife habitat and water quality can result from oil and gas projects that have leaking pipelines. Improper disposal of brine also poses an environmental threat to our natural resources particularly surface and ground water.

Geology and Minerals are addressed in the Final Draft of the State Forest Resources Management Plan. This section of the Plan may be found in Appendix A-4. The Bureau of Forestry's Policy on Geology and Minerals is, "The geology of the state forests will be considered in state forest management operations. The mineral resources on state forest lands will be managed for the long-term good of the citizens of the Commonwealth of Pennsylvania. Any exploration, development, and utilization will be done using environmentally and financially sound methods."

Goals, objectives, guidelines and actions for the state forest lands are laid out in this section of the draft Plan.

Natural Gas as a Community Facility

The availability of natural gas is important to residences, businesses and industries in Centre County. Equitable Production, formerly Eastern States, has 630 gas wells in Centre and Clinton Counties. Fifty percent of these wells are located within Centre County. Equitable Production supplies natural gas to Columbia Gas, Texas Eastern, Transco, Premier Refractories in Clarence, and previously to Corning.

Losing a major user of natural gas, Corning, has created problems for Equitable Production. Since the gas is not 'burned' at the receiving end, the pressure in the lines builds up. Increased pressure in the lines makes it difficult to pump new gas into these lines which decreases production levels for Equitable Production. Equitable also supplies gas to Texas Eastern and Teco but is looking for new markets.

This natural gas company has a local office in Snow Shoe; however, its main office is in Charleston, West Virginia. Equitable Production is the largest producer in the County; however, there are smaller, independent companies that also pump natural gas and market it.

Smaller companies have the option to sell their natural gas through contracts. Dominion has high pressure trunk line that these companies tap into for transmission of the natural gas. Dominion owns and operates the Leidy Storage Fields located in Clinton County where gas is stored. Reserves are built up during the summer months for winter use.

The Leidy Storage Fields were formerly tapped for natural gas. Once depleted of natural gas, these fields provided a reservoir for natural gas storage. The gas is compressed prior to entering the storage fields in order to increase the storage capacity. The Leidy Gas fields is the largest gas storage facility in the Northeast.

Texas Eastern, a subsidiary of Duke Energy, also has transmission lines running in a north-south direction in the center of the County and a lateral line near the Devil's Elbow landmark in Boggs Township which connects to the main transmission line.

Transmission of natural gas is regulated by the Federal Energy Regulatory Commission (FERC).

Natural Gas and Transportation

Natural gas also provides a clean fuel source for the Centre Area Transit Authority's buses. Currently CATA has 44 buses fueled by natural gas. The natural gas is purchased on the open market.

In addition, the state provides monies to transit authorities to encourage the use of natural gas buses. The Alternative Fuel Incentive Grant Program, administered by the Pennsylvania Department of Environmental Protection, covers a percentage of the cost of purchasing buses.

Future of Natural Gas

It is anticipated that natural gas well exploration will continue at its current rate. One possibility for the future is for companies to drill deeper. The Trenton Black River Formation, deeper than 11,000 feet, is being explored in counties to the north of Centre. If natural gas companies succeed with drilling in this formation then it is anticipated that there will be drilling activity in Centre County to tap into this formation. Currently, there has been preliminary activity in pursuing the Trenton Black River Formation in the central and northcentral part of Centre County. Production in deeper wells, particularly in this formation, may exceed 100 times that of a shallow gas well.

Over 50 permits were issued in Centre County for the first six months of 2003 for shallow gas wells. It is uncertain whether these wells will be developed; however, this trend is expected to continue. Mid-East Oil, Indiana, Pennsylvania, holds roughly 35 of the permits that have been issued this year. The location of these future wells are in Burnside Township. Great Lakes Energy, based out of Ohio and with an office in Pennsylvania, and Texas-Keystone, located in Pittsburgh, were two other gas companies that

received permits for this time period for sites in Curtin and Snow Shoe Townships.

LIMESTONE/DOLOMITE

Limestone is a sedimentary rock, normally white to light gray or buff in color, composed primarily of calcium carbonate and occurring in the form of beds or strata, of considerable uniformity and areal extent. Dolomite is very similar to limestone, however, it contains higher amounts of magnesium.

Lime is one of the major products from limestone quarrying activity. Wherever limestone is of high quality, it frequently is processed.

Limestone found in the Allegheny Mountains and in the Plateau Beds occurs in thin beds mixed with sandstone and shale and is of low purity. In Centre County the limestone deposits are generally southeast of Bald Eagle Creek and in the past quarries were operated for products for local distribution such as agricultural lime, road building material, concrete aggregate and flux[31] for the iron industry.

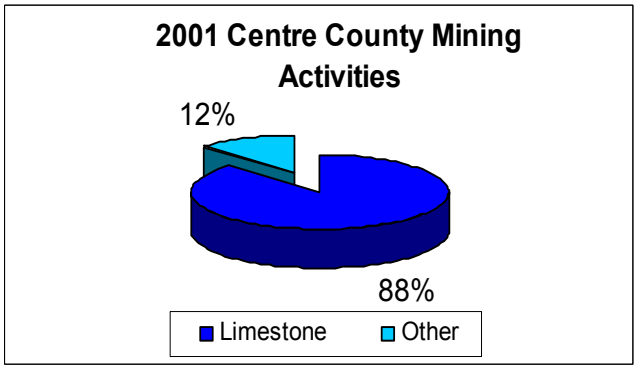
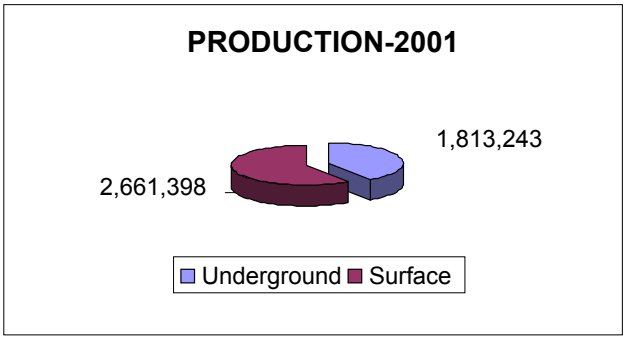


Figure 11: 2001 Centre County Mining Activities

Since 1970, much of the limestone activity has occurred to the south of the Bald Eagle Valley. The quality of the limestone even within one area varies greatly, thus necessitating a separation or grading of the material and identifying the most appropriate use for each grade.

The importance of limestone as an economic resource is graphically illustrated in Figure 11. Limestone/dolomite extraction accounts for 88% of the mining activity in Centre County.

The Pennsylvania Department of Environmental Protection's Annual Mining Report for 2001 lists the total production of limestone in Centre County as 4,474,641 tons. The graph in Figure 12 shows the breakdown of limestone and dolomite extracted from both underground and surface mines in Centre County as well as the number of persons employed in this industry.



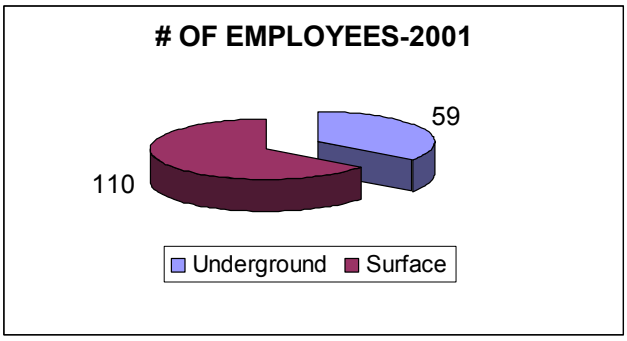


Figure 12: Limestone/Dolomite underground and surface mining statistics for Centre County

This level of importance of this industry is heightened by the presence of the Valentine Member in the Linden Hall Formation. The Valentine Member is over 97% pure limestone and is for the most part unique to Centre County. The Valentine Member may be found elsewhere in the United States; however, it is

[31] Flux is a substance that reduces the melting point of a mixture, as in making glass or ceramics, or that helps metals to fuse. (Dictionary of Geological Terms, Third Edition, The American Geological Institute, 1984)

not recoverable due to the depth at which it occurs. The location of the Valentine vein in Centre County is shown in Appendix A-1. It is important to note that Con-Stone is also quarrying the Valentine Member in Haines Township, but it is not shown on the map since the Valentine is not the uppermost geologic unit. Those reserves were originally owned by Bethlehem Steel and subsequently acquired by Con-Stone.

The table in Appendix A-5 lists the limestone quarries and notes mining operators that quarry the Valentine Member. The lime product from this formation is primarily used for air pollution control as well as in wastewater treatment.

History of Limestone

"County up with quarrying"
Centre Daily Times, June 5, 1994

By the late Hugh Manchester of Bellefonte

Limestone has been a factor in Centre County history for more than 200 years. At first, it was used mainly to construct pioneer homes and buildings.

The front of the State Theatre on West College Avenue in State College is just one example. The entrance and front of the theater were originally part of the G. Murray Andrews mansion which, until the mid-1930s, sat on the northeastern corner of East Howard and North Allegheny Streets in Bellefonte. When the Andrews home was torn down, the contractor, who also built the State Theatre, bought the stone and incorporated it into the theater.

Usually, stone for homes came from a nearby quarry site and the operation wasn't of major proportions. An example can be found along South Water Street in Bellefonte where, if you look closely, you can see on the stone ledge east of the street where the stone was quarried. Another good example is along Route 144, immediately south of Bellefonte, at "The Forge." The site of Frank Royer's office was the source of stone for the nearby "Forge Mansion," the home of the Valentine ironmaster.

Agricultural use

Along Route 26, north of the Jacksonville Road, stands what appears to be a miniature iron furnace. It was, however, used for the production of lime used on nearby farms. A bigger one is south of Route 550, east of Stormstown.

New Methods

The early iron industry in Centre County availed itself of the copious limestone deposits nearby. There remained, however, no quarrying operations on the scale that began with the Civil War and have continued ever since.

By the end of World War I the local leaders of the limestone industry saw the handwriting on the wall and realized that another method would have to be used to continue the success of the industry. Enter Charles Morris, son of A.G. Morris, who had been in the business in the Bellefonte area since 1878. Young Charles got the idea to mine it, running several experiments to confirm his belief. The only question was: Who could do it?

A.G. Morris soon found the answer in Michigan. Miners of Finnish descent, living in that state, were the only ones experienced enough in mining to attempt to sink a shaft and get a bonanza of limestone, which, hitherto, had remained unobtainable. Charles Morris knew this, and with the powerful backing of his father's American Lime and Stone Co., got the project under way. This brought among others, "Cap" Koski to Bellefonte from Michigan. He was a mining expert, and the first shaft was sunk to a depth of 100 feet. Eventually, it went down to 600 feet and, finally, almost to 1,000 feet after World War II. At one time American Lime's underground limestone holdings ran from near Howard in Little Nittany Valley west to Patton Township. Much of it was obtained during the early part of the 20th Century.

Pioneer Companies

The nucleus of the limestone industry in Centre County began in Bellefonte when two obscure men, James Brown and Sam Parks, purchased a small lime operation known as the "Simpson Lime Kiln," located below the residence of

William A. Thomas, near “Sunnyside” in 1869. At the same time Col. William Shortlidge, brother of Penn State President, Joseph Shortlidge, put into operation the “Bellefonte Lime Kilns” in the same vicinity. He was followed by the Alexander brothers, Cyrus T. and James R., who established nearby their “ Sunnyside Lime Kilns.” There, they put two kilns and a quarry operation and the locale was appropriately named “Alexandria.” The remains of that operation can still be seen on the road to Sunnyside.

Alexander Gilcrest Morris came to town from Tyrone is 1878 and bought Shortidge out, naming his enterprise The Morris Lime Co. In 1901, Morris organized a local “lime trust” when he put his holdings, and those of others, into a firm that he called The American Lime and Stone Co. One of its first acquisitions was the Alexander firm. After “A.G.’s” death in 1924, the Warner Co. of Wilmington Del., and Philadelphia gained control of the company, which lasted up until recent times when Bellefonte Lime Co. took over. Under Warner it became the “Bell Mine,” famous the world over. Warner made a major contribution when it installed huge rotary kilns for the production of lime, gradually phasing out the old kilns. Among the latter were the firms’ giant kilns in Armor Gap, north of Bellefonte.

While attention was focused on the Bellefonte area, L.A. Schaeffer, Bellefonte, and W.H. Noll, Pleasant Gap, founded “Whiterock Quarries, “ gaining the underground limestone rights from McBride Gap, opposite Rockview, east to the old Gentzel farm near Zion. In the beginning, their production went primarily to The Nittany Iron Furnace, Bellefonte. One of their partners was Noah H. Swayne, manager of the iron firm and closest living relative of George Washington. Another partner was Attorney John Blanchard of Bellefonte.

Tom Shoemaker, nephew of famed railroad contractors, the Collins Brothers, built a milelong railroad spur that connected the Whiterock Quarries with the Lewisburg and Tyrone Railroad at Pleasant Gap. Shoemaker, of Bellefonte, built the famed Northumberland railroad yard and put in the Pennsylvania Railroad curve at Lewistown.

Chemical Lime, located west of the American Lime, north of the Buffalo Run Road, came next in 1907. Prime movers in this venture were A.C. Mingle, John I. Olewine, John S. Walker, William Allison and Andy McNItt. In 1929, McNitt became Centre County’s greatest “unsolved mystery.” He disappeared on a train trip to Florida. Even today, some folks wills say, “Where’s Andy McNitt?”

Chemical Lime began with the purchase of the limestone lands and kilns of the Charles Witmer Estate, more than 100 acres, and built 10 large kilns and a grinding mill. Its lime products supplied the chemical and medical industries, concrete work and the manufacturers of glass. By the mid-1930s, it became National Gypsum, later Domtar, and today, Con-Lime. Following American Lime, it, too, went into underground mining and the use of large rotary kilns. The mine continues today and the firm practices no quarrying. Bellefonte Lime used its mine in April of 1987 and has centered its operation today between Pleasant Gap and Zion, south of Route 64, on the old Gentzel farm.

The Empire Lime Co., a creation of Conrad Miller, Bellefonte, functioned as early as 1913 in quarrying operations adjacent to those of American Lime at Armor Gap. Later his son, Martin, kept the family tradition going in the Jacksonville area, reaching his zenith in World War II.

Oak Hall is the scene of a substantial quarry operation that began in 1917 when Philip Dale of Oak Hall organized the Oak Hall Lime Co. and proceeded with quarrying operations on “Limestone Hill,” a part of the nearby Old Dale homestead. Still in operation, it is known today as HRI Inc., which also operates a similar quarrying business near the Bellefonte interchange of Interstate 80.

Another important limestone quarrying operation was Black Hawk in Brush Valley, west of Centre Hall.

In 1950, Standard Lime went into operation in Spring Township, adjacent to the old Bellefonte Airport. Successors to it included Martin-Marietta Inc. It began chiefly as a mining operation and it was connected to the Lewisburg

and Tyrone Railroad at Pleasant Gap by a railroad spur several miles long.

Early Days

Bellefonte firms in the limestone business 125 years ago sold their products by the bushel-at nine cents each. Production between the Alexander brothers and Col. Shortlidge totaled from 500 to 900 bushels per day.

The purity of the local limestone was between 97.5 to 99 percent carbonate of lime, among the purest in the world.

Many Central, Eastern and Southern European immigrants were attracted to the Bellefonte limesonte industries at the end of the 19th century and into the 20th century.

One place they settled was in red American Lime-built house at Red Roost, north of Bellefonte. All vestiges of those houses are gone. Another "housing development" was "Brick Row" on North Spring Street. It remains, but was remolded long ago.

Quarrying in those days was dangerous and, for some, the Catholic Cemetery in Bellefonte became the final resting place in short order.

Whatever, the amount of lime products shipped out of Bellefonte for years, along with products of other local industrial firms, made Bellefonte one of the leading freight shipment centers in Pennsylvania. Much of Bellefonte Central Railroad's revenue came from the National Gypsum and Warner firms.

In 1913, Italian laborers at Whiterock were housed there in "The Italian Quarters." At Morris a stop on the Bellefonte Central, Italians and Hungarians were domiciled at "The Big Bean Hotel."

"Hungarian" was a local classification of anybody who came here from the Austrian-Hungarian Empire of that day.

This article was part of a three-day series of articles on the limestone industry in Centre County. The Centre Daily Times granted permission to reprint this article.

Current Status of Limestone Quarry Operations

Hugh Manchester's historical perspective on limestone quarry operations gives us a look back in time. It also illustrates how times have changed. Two of the quarry operations are now owned by international companies, Hanson Aggregates Pennsylvania and Graymont (PA) Inc. Both are recognized as top producers of limestone products in the world.

Graymont (PA) Inc. recently acquired Con-Lime deep mine along the Bald Eagle Mountain. The mine is currently inactive. In addition, this company has recently been granted a permit by the PADEP to deep mine along the base of Bald Eagle Mountain, a 2.3 mile swath. Graymont (PA) Inc. will be mining a 100 foot vein of the Valentine Member in Benner and Patton Townships. Originally, this permit application came under strong opposition in the mid-1990s since it was intended to be a 171 acre surface mine in these two municipalities. The application was challenged legally in both townships. The end result was to allow the mining to occur below the surface.

Access to rail shipment gives Graymont (PA) Inc. a competitive edge in Centre County.

Hanson Aggregates Pennsylvania quarries aggregate stone. Close to 100% of its products are used in Centre County. They are also the primary supplier for HRI's two asphalt plants which are located at Hanson's Oak Hall and Curtin Gap Quarries.

In 2002, this company sought to expand its Oak Hall Quarry in College Township by requesting a rezoning of a privately owned contiguous parcel of land. The request was to rezone 42 acres of land from agriculture to allow for mining in return, Hanson offered to set aside a 62.5 acre buffer to be preserved as open space. The rezoning would have allowed Hanson Aggregates Pennsylvania to continue at its current level of production. Strong opposition to this proposal was based on concerns on the impact the quarry could have on neighboring communities and close proximity to the Mount Nittany Middle School. Blasting, dirt, heavy trucks, noise, and impacts to Spring Creek were some of the concerns raised.

College Township took no action on the rezoning request.

The Curtin Gap Quarry operation, Marion Township, is near the end of its permitted area. The I-99/I-80 proposed intersection is also close to this site. Hanson Aggregates Pennsylvania has applied for a permit to expand this operation and sought a rezoning of 78.3 acres of land from Planned Commercial and Forest to General Industrial. Marion Township approved the rezoning request. Hanson's other operation in Marion Township is the Jacksonville Quarry. This quarry is currently inactive as well as their Black Hawk Quarry in Potter Township.

Glenn O. Hawbaker Inc. operates the Whiterock Quarry and the former Centre Lime & Stone Quarry in Spring Township. Aggregate and high-calcium lime are quarried at these facilities.

The development of Con-Stone Inc.'s operation in Haines Township was also not without controversy. These reserves were formerly owned by Bethlehem Steel. In 1992, Con-Stone applied for a permit to quarry 73 acres of land southeast of the historic village of Aaronsburg. In addition to concerns raised with other similar permit applications, this quarry proposal was geographically located near exceptional value and high quality streams, native trout fisheries and unique cave features. An attempt was also made to declare this area as Unsuitable for Mining for Noncoal.

Future of Limestone/Dolomite in Centre County

As Centre County's population grows and as development continues to spread out into the outlying areas where these resources exist, conflicts like the ones mentioned between the mineral industry and its residential neighbors will continue. Depending on market conditions and remaining reserves, limestone operations may need to look to expand to meet market demands. With the Valentine Member being a unique economic resource, holdings of these reserves are a valuable commodity.

Regulations and Limestone/Dolomite

The PADEP regulates noncoal operations under Title 25 of the Pennsylvania Code, Chapters 77 and 277. The large scale operations such as the ones listed are inspected by the Department four times per year. Small scale noncoal operations are inspected annually.

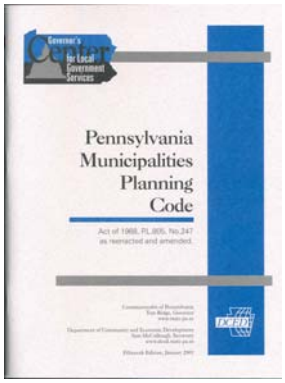
Air pollution laws and the Clean Streams law regulate air emissions and discharges to water.

Safety concerns are covered under the Federal Mine Safety and Health Act.

MINERAL RIGHTS

Mineral rights may or may not be part of a deed to a property. Most often, they are treated as a separate interest in land, which may be sold separately from the surface rights. A deed for the mineral rights may be recorded in the County Recorder of Deeds Office. Property owners in areas identified with having mineral resources should be aware of who owns the minerals beneath their ground.

MINING AND LAND USE PLANNING



Minerals in the *Pennsylvania Municipalities Planning Code* (MPC) are defined as, "Any aggregate or mass of mineral matter, whether or not coherent, the term includes, but is not limited, to limestone and dolomite, sand and gravel, rock and stone, earth, fill, slag, iron ore, zinc ore, vermiculite and clay, anthracite and bituminous coal, coal refuse, peat and crude oil and natural gas."

Preservation and Protection in the MPC is defined as "When used in connection with natural and historical resources, shall include means to conserve and safeguard these resources from wasteful or destructive uses, but shall not be interpreted to authorize the unreasonable restriction of forestry, mining or lawful uses of natural resources."

As provided for in the MPC, local governments interested in planning for and regulating mining

operations shall not adopt regulations that supersede state legislative acts. These acts are as follows:

- The Clean Streams Law
- Surface Mining Conservation and Reclamation Act
- The Bituminous Mine Subsidence and Land Conservation Act
- Coal Refuse Disposal Control Act Oil and Gas Act
- Noncoal Surface Mining Conservation and Reclamation Act

In addition, Section 603.i of the MPC states that "zoning ordinances shall provide for the reasonable development of minerals in each municipality." The MPC, however, does not define 'reasonable.' Municipalities participating in a multi-municipal comprehensive planning effort may share 'uses' providing for mineral resource development in a much larger geographical area and not just confined to a municipal boundary.

The Pennsylvania State Association of Township Supervisors publication, *"What Can We Do? A Look into Municipal Powers and Land Use Controls Governing Mining Activities,"* provides guidance for municipalities in planning for mineral resources. The guidelines are:

1) *Do not attempt to provide stronger or weaker measures than those already prescribed by state/federal law; they are preeminent.*
2) *Make ordinances measurable/specific; avoid overbroad or vague wording.*
3) *Be careful not to violate equal protection.*
4) *Do not intentionally (or unlawfully) discriminate.*
5) *Make sure what you're creating has a real, reasonable relationship to legitimate government purpose.*
6) *Do not attempt to impede interstate commerce.*

NATURAL RESOURCES GOAL

Identify, preserve, and monitor Centre County's environmental natural resources for the benefit of present and future generations.

GEOLOGY AND MINERAL RESOURCES OBJECTIVES

Promote the wise use and management of the County's natural resources that include prime agricultural lands, forested areas, and mineral resources.

Protect watershed features such as surface and underground water supplies, streams, floodplains, wetlands, fish and wildlife habitats, and aquifer recharge areas.

Promote growth within Communities that is compatible with the surrounding homes and businesses.

Reduce air, water, land, noise, and visual pollution.

Develop strategies that provide for growth while maintaining a balance with the County's natural resources: ag lands, sensitive environmental areas, steep slopes, floodplains, scenic views, and high quality surface and ground waters.

RECOMMENDATIONS


Allow for the 'reasonable expansion' of mineral extraction operations which is consistent with historic production levels.


Encourage mineral resource utilization as an economic development measure that is consistent with County and local comprehensive plans.


Encourage underground mineral extraction of high quality limestone to reduce impacts to above ground natural resources.


Buffer new mineral extraction activities from incompatible neighboring uses.


Protect surface and ground waters from pollution or dewatering resulting from mineral extraction activities.


Locate mineral extraction industries along roads constructed to handle heavy equipment and truck traffic and minimize or provide alternatives for mineral industry traffic in residential neighborhoods and central business districts.


Avoid impacts to historic resources when exploring, extracting or transporting minerals


Encourage the reclamation of limestone quarry operations with reclamation plans once an area of the mine has been quarried.


Promote the adaptive reuse of limestone quarries once the reserves have been depleted.


Discourage mineral extraction activities or facilities in identified wildlife habitats and sensitive environmental areas, i.e., Natural Heritage Inventory sites.

- Encourage multi-municipal planning for land use as a tool to manage mineral resource utilization.

- Support and pursue Growing Greener or other funded projects designed to treat acid mine drainage.

- Coordinate with other County agencies and watershed associations on acid mine drainage or mineral extraction concerns.

- Monitor the permitting and development of natural gas wells in the County as related to the protection of forest resources, ground and surface waters, sensitive natural areas and wildlife habitat.

- Monitor the effectiveness of state regulations for the utilization and extraction of mineral resources and communicate and encourage the state to revise any regulations which are found to be inadequate.

- Proposed development within Carbonate Geology areas should be accompanied by thoroughly investigated site locations to ensure that construction takes place in areas that are free from collapse and will prevent groundwater pollution.

- Lobby for re-enactment of the Surface Mining Control and Reclamation Act, and a more rapid release of funds to accelerate reclamation of abandoned mine land, even if the fund must be moved “off budget” so that its resources are not held to lessen the Federal budget deficit.

APPENDICES

GEOLOGY AND MINERAL RESOURCES

APPENDIX A-1

CENTRE COUNTY MINERAL RESOURCES MAP

To be included.

APPENDIX A-2

ABANDONED MINE PRIORITIES AND DEFINITIONS

APPENDIX A-3

FISERIES IMPACTED BY ACID MINE DRAINAGE IN CENTRE COUNTY

APPENDIX A-4

STATE FOREST RESOURCES MANAGEMENT PLAN
Geology and Minerals Section

APPENDIX A-5

CENTRE COUNTY LIMESTONE QUARRIES